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ABSTRACT

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Play and Cognition: A Study of Pretense Play and Conservation of Quantity

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Play and Cognition: A Study of Pretense Play and Conservation of Quantity

Abstract

The relative effectiveness of four different training conditions on the attainment of conservation of quantity was examined in a 5-Group design. Subjects were 75 nonconserving preschoolers, ranging in age from 3.10 to 5.0 years. Treatment consisted of pretense play training, direct conservation training, a combination of pretense play and conservation training, mere exposure to the conservation tasks without the benefits of instruction, and a control condition which provided only conservation pre- and post-tests. The results of the two conservation posttests indicated that a combination of pretense play and conservation training was the most effective condition, followed by the conservation training and then by the pretense play training. The data also indicated that the effects of conservation training were less stable than those attained with pretense play training, and that the former tended to decrease with time while the latter showed a corresponding increase over time.

Play and Cognition: A Study of Pretense Play and Conservation of Quantity

The last decade has seen a renewed interest in children's pretense behavior. Many investigators have puzzled over the significance of pretense or symbolic play for human development and have attempted to delineate its potentially adaptive functions (Bruner, Jolly & Sylva, 1976; Feitelson & Ross, 1973; Herron & Sutton-Smith, 1971; Klinger, 1971; Millar, 1968; Singer, 1974; Slobin, 1964; Smilansky, 1968; Tizard & Harvey, 1977; Vandenberg, 1978), with special emphasis on cognitive aspects of symbolic play (Burns & Brainerd, 1979; Curry & Arnaud, 1974; Dansky & Silverman, 1973; Fein, 1975; Fink, 1976; Franklin, 1973; Garvey, 1977; Golomb, 1977; Johnson, 1974; Saltz, Dixon & Johnson, 1977; Schempp-Matthews, 1977; Stern, 1976).

What are the cognitive capacities essential to a game of pretense? Are they play-specific skills, applicable only to imaginary activities, or are they common to other forms of cognition? Piaget's answer to this question has focused on what appears to him as the undisciplined character of symbolic play. He contends that the playing child cannot differentiate between the signifier and what it signifies, i.e., between the symbol and its referent. Accordingly, the child does not maintain the distinction between reality and fantasy and these two modes of thought fuse into a state of genuine "belief" that permeates his game. Piaget (1962) characterizes symbolic play as a form of egocentric thought which is distorted by assimilatory processes and reflects the cognitive imbalance typical of the preschooler's thought structures. He perceives play symbolism as a symptom of the child's conceptual immaturity that, like egocentric language, needs to be outgrown. In his account of play Piaget

underestimates the significance of the child's "as if" behavior, and ignores the child's ability to maintain a dual orientation to the world of reality and of pretense. Piaget overlooks the restrictions which the child imposes on his rule-governed games, and the clear distinctions which are maintained between the dual functions of objects and role-identities in pretense.

To the present writers the child's ability to adopt an "as if" stance is the most outstanding characteristic of pretense play and, in itself, represents a form of reversible thought. In pretense play the child seems to employ an intuitive form of reversibility: he performs reversible mental transformations which run counter to the observable perceptual reality. Every time a child adopts a role and pretends to be someone other than himself, he engages in a mental transformation which is not matched by physical reality. When he discards his temporary role and readopts his usual identity, the imaginary transformation is reversed and his former self reinstated. If the reversibility seen in pretense play is a spontaneous precursor of the genuine reversibility of operational thought, can the exercise of pretense play be utilized for the induction of more advanced forms of reasoning? More specifically, if the structure of pretense play reasoning is characterized by primitive operations of identity, inversion, and compensation, might we not predict that pretense play training should affect conservation achievement? This thesis was explored in two studies which examined the relationship between the reversibility seen in pretense play and the reversibility demonstrated in the solution of the conservation problem. Preschool children were exposed to symbolic play situations in which questions about their pretense actions, specifically, those concerning the original identity of the object, its transformation during play, and the return of its original and

enduring identity at the end of the game, induced reflection on and verbalization of behavior usually taken for granted. The effects of this symbolic play intervention procedure on the child's attainment of conservation were then examined.

The first study (Golomb & Cornelius, 1977), a 2-Group Design, attempted to demonstrate that a relationship exists between pretense reversibility and the reversibility manifested in conservation-type tasks. The subjects were 30 nonconserving 4 year olds attending a middle-class nursery school. Four conservation pretest trials established the nonconserving status of the participants. Following the conservation pretests, 15 children were assigned to the pretense play condition which consisted of 6 pretense play episodes extending over 3 days. After each pretense game, a brief inquiry was conducted which questioned the child's symbolic transformations and his explanations of pretense play. The control group also comprised 15 subjects matched to the experimental subjects on the variables of age, sex, socio-economic status, and attendance at a nursery school. These subjects were assigned to a constructive play condition consisting of 6 arts and crafts play episodes also extending over 3 days. Following the play sessions, all children were retested on the conservation tests. The differences in conserving responses between the two groups of subjects were large and statistically significant, favoring the pretense play training condition. In the experimental group, 10 out of 15 children gave accurate conserving judgments and explanations; by contrast, of the 15 children engaged in constructive play activities, only one child became a conserver. It is of considerable interest that conserving judgments were always accompanied by correct explanations with an appeal to rules of identity, inversion and or compensation. These forms of justification suggest that the training in pretense elicited a genuine form of logical

reversibility which facilitated the acquisition of conserving judgments and explanations.

The second study (Golomb & Adams, 1978), a 3-Group Design, attempted to replicate the Golomb & Cornelius effect (1977), while exploring more fully the play conditions under which conservation of quantity effects could be attained. By contrast with the child's usual pretense play experiences, the ones we provided were quite specific and guided by explicit theoretical assumptions. Primarily, the study was designed to clarify whether it was pretense play with verbal inquiry or pretense play per se that induced successful conserving responses. The study also included an extended series of eight conservation pretests with a detailed set of six questions per task, a group of new posttests to assess the generality of the effect, and two additional and delayed posttests to determine the stability of the conceptual gains made during pretense training. This study employed three groups of 4 year old middle-class children who were given conservation of quantity pretests to establish the nonconserving status of all the participants. Following the pretests, 30 children were randomly assigned to one of three conditions: pretense play with inquiry, pretense play without inquiry, and a control condition in which subjects were only pre- and posttested. Three posttests were given on days 5, 14, and 28 following the initial conservation pretests. Although the three groups of subjects did not differ significantly on the first and the second posttest , the overall differences between the two treatment groups and the control group attained statistical significance on the third posttest. Paired comparisons between groups showed that the pretense play with inquiry condition yielded significantly more conserving responses than either of the other two groups. In the "inquiry" condition, 80% of the subjects showed some degree of change in their conservation test

scores on the third posttest compared with 25% of the subjects in both the "without inquiry" and the control conditions. In summary, the Golomb & Adams study isolated the "inquiry" condition as the effective variable, and demonstrated that the training effect generalized to new tasks and was maintained over time. However, the fact that statistically significant differences did not appear until the third posttest presented a problem. The authors attribute the delayed appearance of the training effect (a "sleeper" effect) to the specific procedural modifications which they introduced in this design. Unlike the limited number of conservation pretests used in the Golomb & Cornelius study, Golomb & Adams increased the number of pretest trials as well as the number of questions which the child had to answer. Thus they created, unwittingly, a condition which reinforced the child's nonconserving responses a total of 48 times (8 pretests X 6 questions per task). Apparently, this counterproductive procedure masked the effects of the pretense training, which did not emerge until 22 days after the training was completed.

The previous findings suggest that four year old preschoolers can successfully apply problem solving strategies activated in play to conservation of quantity tasks. Furthermore, the Golomb & Adams study isolated the verbal inquiry condition as the effective variable in the training procedure. In this condition the verbal interchange at the end of each game encouraged the child's production of identity and reversibility explanations, which were then summarized by the experimenter. Thus, the child was provided with a semi-logical verbal rule for his pretense behavior. These findings lead to the following questions: (1) If the provision of a verbal rule for pretense play facilitates the attainment of conservation, how does this procedure compare with the standard highly effective method of direct conservation training (Brainerd, 1974, 1977; Denney, Zeytinogly, & Selzer, 1977; Feigenbaum, 1971;

Field, 1977, 1979; Rosenthal & Zimmerman, 1972; Zimmerman & Lanaro, 1974)? (2) If both pretense play and conservation training are effective inducers of conserving responses, does a combination of these two treatments enhance the magnitude of the effect? If pretense play does indeed activate already existing cognitive structures, would additional direct conservation training be more easily assimilated? (3) Since mere exposure to pretense play with inquiry produces specific cognitive changes relevant to the conservation task, does mere exposure to the conservation problem, which in our design includes a similar inquiry phase, also trigger a comparable cognitive shift?

The present study was designed to explore these issues, as well as to replicate the original Golomb & Cornelius (1977) findings. We were particularly interested in comparing the overall effectiveness of direct conservation training which emphasizes the provision of verbal rules with the more loosely structured pretense play training which provides rules for the transformations used in pretense. In designing the conservation training conditions we selected procedures reported to be most effective for the training of nonconservers, namely, providing verbal rules and feedback, reinforcing the child's conserving judgments and explanations, and correcting false responses (Denney et al., 1977; Field, 1977; 1979; Zimmerman and Lanaro, 1974). Our design involved four treatment conditions: (a) pretense play training with inquiry, (b) direct conservation training, (c) a combination of pretense and conservation training and (d) exposure to the relevant conservation training tasks without the benefit of instructions. A fifth group - the control group - was given conservation pre- and posttests only.

If, as our previous discussion suggests, pretense play activates already existing cognitive processes of identity, inversion and compensation, and may thus facilitate the assimilation of information provided by direct conservation training, then the combination of pretense and conservation

training should produce the best results. We would also predict more immediate effects from direct conservation training than from pretense play. While pretense has the potential advantage of activating already existing cognitive structures, direct training has the benefit of exposing the child to relevant discriminative experiences in addition to the basic conservation rules. Finally, we would expect mere exposure to the conservation training tasks to be slightly more effective than the control condition, which only tests the passage of time. To summarize our predictions, the most effective condition should be the combined pretense and conservation treatment, followed, in order, by direct conservation training, pretense training and mere exposure to the tasks. The control condition should yield the least improvement.

Methods

Subjects

Subjects were 75 nonconserving 4 year olds drawn from seven middle-class nursery schools and daycare centers.[1] All the participants came from towns surrounding Metropolitan Boston. Their ages ranged from 3.10 to 5.00 years, with a median age of 4.6 years. The children, 39 boys and 36 girls, were selected on the basis of their conservation pretest scores. (See Table 1 for mean ages and IQ).

Insert Table 1 about here

Experimental Design

All of the children were given conservation pretests to establish their nonconserving status (see Scoring Criteria). The children were also tested on the Peabody Picture Vocabulary Test to determine developmental level. Following the conservation pretests, nonconserving subjects were randomly assigned to one of five conditions: (a) pretense play-training, (b) conservation training, (c) a combination of pretense and conservation training, (d) repeated

exposure to the conservation training tasks without the benefit of instruction, (e) and a control group which received only conservation pre- and posttests.

All 75 subjects participated in conservation pretests on Day 1. On Days 2, 3 and 4, the four experimental groups received training, either in pretense play, in conservation of quantity, in a combination of play and conservation, or in mere exposure to the conservation tasks. On Days 5 and 19, all five groups were given conservation posttests. All sessions were administered individually, tape-recorded, and transcribed.

Tasks and Procedure

Conservation Pretests, Day 1. Each subject was tested on four conservation of quantity tasks: two dealt with solid quantity and two with liquid quantity. The solid quantity tasks presented the subject with two equal size balls of playdough, 5 cm in diameter, which were transformed, in the first task, into a sausage, 12 cm in length, and in the second task into a pancake, 10 cm in diameter. In the liquid quantity tasks the child was presented with two identical beakers, 9 cm high by 6 cm in diameter, filled with water and with a third beaker, empty and different in size. On the third task, water from one of the identical beakers was poured into a third beaker, 10 cm high by 5 cm in diameter; on the fourth task, liquid was transferred from one of the identical beakers into another beaker 2.5 cm high and 13.8 cm in diameter. On each one of the tasks, the examiner first established the equality of the two balls of playdough or of the liquid contents of the beakers and, following their respective transformations, asked a series of questions: "Do both of these have the same amount of clay (water) or does one have more?" "How do you know?" "I can see that this clay (water) looks longer (taller) but does it mean that it has more clay (water)?" "How much clay (water) was there to begin with?" "How much is there now?" "How did this happen?" "Now I am going to put this clay (water) back the way it was. Now, do both have the same amount of clay (water)?"

Conservation Training, Days 2, 3, 4. The training tasks involved six different stimulus transformations: four were identical with those of the pretest and two were new: one ball of playdough was transformed into a 30 cm long snake, and the liquid of one of the identical beakers was poured into a beaker 25 cm in height and 2.5 cm in diameter. Daily sessions consisted of one liquid and one solid conservation of quantity task. First the examiner modeled a correct judgment: "Now both of these have the same amount of clay (water)." Next she offered one of three types of explanations, a different one for each of the three training days. In the case of identity, she used the following format: "Even though they look different, we know that they both have the same amount of clay (water) because they both had the same amount to begin with and we haven't added any clay (water) or taken any away." In the case of inversion, the examiner stated: "Even though they look different, we know that they both have the same amount of clay (water) because we can always put this one back the way it was," and demonstrated it in action. In the case of compensation, the explanation was offered in the following terms: "Even though they look different, we know that they both have the same amount of clay (water) because even though this one is longer (taller), it is also thinner (narrower)." Judgments and explanations were offered twice, in succession, with a question regarding the child's opinion inserted between the two statements. Thus, the examiner modeled a correct judgment and explanation and also corrected the child's wrong assertions. The order of the presentation of the tasks remained constant, but the order of the verbal rules presented with each daily set of tasks was counterbalanced.

Exposure to the Conservation Training Tasks, Days 2, 3, 4. This condition involved the presentation of the same six tasks used in the conservation training treatment without the benefit, however, of any feedback. Daily sessions consisted of one liquid and one solid conservation of quantity task.

The procedure called for the child's judgment and explanation of the quantities.

Pretense Play Training, Days 2, 3, 4. Six pretense play episodes, each approximately 15 minutes in duration, were played in three daily sessions, two games per session. The games were played in the following order: Picnic, Mountain Climbing, Picking Strawberries, Horseback Riding, Car and Boat Ride, Pet Shop. Each game first engaged the child, together with the experimenter, in a pretense situation and then required his/her explanation of the pretense object and action. The child was questioned about his/her make-believe behavior and encouraged to explain the reversibility of the transformation from the original identity to the pretense identity and back to the original and enduring identity. (For play themes and procedures, see Golomb & Cornelius, 1977).

Combined Conservation and Pretense Play Training, Days 2, 3, 4. In this condition, subjects received, on each of the three days, conservation training on two tasks (see Conservation Training), followed by training in two pretense play games (see Pretense Play Training).

Conservation Posttests, Days 5, 19. Identical sets of posttests were administered on days 5 and 19. They included the six tasks used for conservation training and two additional new ones: a solid quantity task in which one of the playdough balls was transformed into four equal size small balls, and a task involving discontinuous quantity, namely, beans. The beans were first displayed in two identical containers, 6.9 cm in height with diameters of 5 cm at the base and 8.8 cm at the top. Next, the beans of one of the containers were transferred to a beaker 6.9 cm high and 5 cm in diameter. The procedure was identical for all tasks and followed the format established for the conservation pretests.

Scoring Criteria

Conservation Test Scores. The scoring procedure for pre- and posttests was identical. A correct conserving judgment received a score of 1,

a correct explanation offered in terms of identity, inversion, or compensation also received a score of 1. Thus, a nonconserving answer was scored 0, a correct conserving judgment was scored 1, while a correct judgment followed by a correct explanation was scored 2. However, for purposes of analyses the judgment-only category was discarded.[2] Only nonconserving subjects, whose score on the conservation pretest was 0, participated in our study. The maximal possible score for each subject on the posttest was 16. Two independent raters coded all the conservation pre- and posttests from transcripts of the tape-recorded sessions. Percentage of agreement was 93%.

Imaginative Play Ratings. The pretense play sessions were scored on a 3-point scale for the child's imaginative involvement in the games, as measured by appropriate change of voice and/or bodily involvement, improvisation beyond that required of the adopted role, extent of involvement, and desire to continue the game.

Results

The data were analyzed with the Kruskal-Wallis one way analysis of variance by ranks (Siegel, 1956).[2] Since the scores for the repeated exposure group did not differ from the control group, it was eliminated from further analysis. The overall differences between the four treatment groups were statistically significant on both posttests: posttest 1, H(uncorrected for ties)= 11.44 ($p < .01$); posttest 2, H (corrected for ties) = 10.07, $p < .02$.

The pattern of conservation scores confirmed our prediction. The highest scores were obtained in the condition which combined conservation and pretense play training, followed by conservation-only training which yielded better scores than pretense play training, which in turn was superior to the control condition. The distribution of conserving responses for the various groups is presented in Table 2.

Insert Table 2 about here

The results can also be described in terms of the number of subjects who, in each of the conditions, became conservers, i.e., who gave accurate judgments and explanations on all or some of the tasks (see Table 2). In order to ascertain whether the differences between the various treatments were large enough to be statistically significant, a set of comparisons between the individual groups was performed (Mann-Whitney U Tests, Siegel, 1956). On the first posttest, these comparisons indicated that the combined treatment was superior to all other groups: conservation-only ($U = 61$), pretense ($U = 58.5$) and control ($U = 49.5$), all p's $< .025$. None of the remaining comparisons achieved statistical significance. On the second posttest, only the combined treatment was significantly better than the control group ($U = 56$, $p < .025$, see Table 3).

Insert Table 3 about here

The extent of generalization of the various training effects to the new tasks was assessed on two tests: a solid conservation task where the transformation yielded four balls of playdough, and a discontinuous quantity task using beans. The results for the two groups which received direct conservation training (conservation-only and the combination of pretense and conservation) were modest. On the first posttest, two subjects in the conservation-only group and three subjects in the combined group gave a correct response on the solid quantity task and one subject in each group conserved on discontinuous quantity. On the second posttest, one subject in the conservation-only and three subjects in the combined treatment group gave a corret conserving response on the solid quantity task; two subjects in the conservation-only group and four subjects in the combined group gave a correct response on discontinuous quantity.

Additional information on the number of children who in each group conserved one, two or three kinds of tested quantities, namely, solid, liquid and/or discontinuous quantities is presented in Table 4. The results favor the combined treatment condition.

Insert Table 4 about here

An examination of the changes in test scores over the two-week period from the first to the second posttest indicates different patterns for the treatment groups. In the pretense play group, the scores of the two conservers increased. In the conservation-only training group, four conservers decreased and two conservers maintained their scores. None of the conservers showed an increase. In the combined play and conservation treatment group, four conservers increased and five decreased in their scores. The differences between the scores on the two posttests are not the result of children losing the explanation while retaining their conserving judgments. Rather, the decrease occurred in both judgments and explanations.

The extent of the relationship between the child's imaginative involvement in pretense play and his conservation scores was also explored. Correlational analyses confirmed a modest, though statistically significant

relationship; on the first posttest, $r = .36$, $p = .026$; on the second posttest, $r = .31$, $p = .046$. Separate analyses of covariance indicated that the variables of IQ, MA, CA, and sex did not have a statistically significant training effect.

Discussion

The present study was designed: (1) to compare the effects on conservation attainment of specific conservation training with those of pretense play training; (2) to assess the effectiveness of combined pretense and conservation training on conservation attainment; (3) to determine whether exposure to the conservation task is a sufficient condition for the induction of conservation; (4) to replicate the original finding (Golomb & Cornelius, 1977) that training in pretense play facilitates the acquisition of conservation.

A comparison of the relative effectiveness of specific conservation training and pretense play training indicates a large difference in the number of conserving subjects and in the total scores obtained in the two conditions, a difference which favors the direct conservation training treatment. Although these differences decline on the second posttest, the scores obtained on direct conservation training are substantially larger than the ones obtained on pretense play. This seems to confirm our prediction that direct and specific training, which repeatedly offers a verbal rule and also verbally corrects the child's responses, is a more effective inducer of conserving responses than the indirect training method of pretense play. On further inspection, however, the low incidence of correct explanations offered on the second posttest raises the question: why is the effect of

direct and intensive training so modest? While the number of correct judgments and explanations following conservation training (13) exceeds that obtained on pretense training (8), the difference of five additional correct judgments and explanations is not impressive and falls short of the number of correct judgments and explanations (24) offered in the combined condition. The change in scores from the first to the second posttest also indicates the limitations of the conservation training method employed in this study. Although the scores for the pretense group increase on the second posttest, those for the conservation-only group decrease. Thus, while teaching the child a verbal rule has an immediate effect, as measured by the scores obtained on the first posttest, the gains are not fully maintained. Apparently, the provision of correct information does not insure the child's understanding of the problem and its solution and, taken in isolation, may fail to be assimilated by many young children. To the extent that the modeled judgment and explanation does not make sense to the child, its learning effect will be unstable and decline with the passage of time. We might perhaps speculate that had we included a third posttest, the scores for the pretense play group would have further increased, while those for the conservation training group would have shown an additional decline. By comparison with conservation training, the pretense play condition seems to have induced more lasting cognitive changes. This is quite remarkable since pretense play training merely encouraged children to give an account of the spontaneous reversibility demonstrated in their pretense transformations, while conservation training directly and explicitly modeled correct judgments and explanations.

This interpretation of pretense and conservation training is supported by the performance of the combined group. The finding that only the combined pretense and conservation group benefited significantly from training indicates the effectiveness of this treatment for the induction of conservation. On the first posttest, the scores of this group were significantly higher than those of the pretense, exposure and control groups and on the second posttest they were significantly better than those of the exposure and control groups. In comparison with the conservation-only condition, twice as many children in the combined group conserved liquid quantity as well as two (solid and liquid) or three (solid, liquid and discontinuous) quantities. Finally, the combined group, unlike the conservation-only group, maintained its high scores from the first to the second posttest. Thus, the combined pretense and conservation condition provided both the magnitude of the effects produced by direct conservation training and the longevity of the cognitive changes induced by pretense play training.

The present results do not support the suggestion that mere exposure to the relevant tasks is enough to trigger a shift toward conservation. While a single subject in the exposure group gave a correct judgment and explanation on one of the tasks in the second posttest, the differences between this group and the control group were not statistically significant.

Finally, we must consider the reasons for the relatively modest effects achieved in all training conditions, including pretense play. In general, when replication studies use small samples one might expect differences in the magnitude of the obtained scores. In addition, inspection of our

protocols suggests, in a highly tentative fashion, that such examiner variables as maintaining the child's attention, insisting on a reply and repeating a conflict inducing question, may have affected the results. For our study, and particularly in the pretense play condition, it is of central importance to maximize the child's attention to our series of inquiry questions and to maintain his/her interest in them. While all children enjoyed the pretense play session, many seemed to respond to the questions posed by the experimenter as an interruption of their game, and they attempted to abbreviate this interlude in order to resume, as quickly as possible, their pretense activities. Thus, inattention to our pretense questions and a tendency on the part of the child to offer routinized answers may have militated against the development of the full impact of pretense play training. Furthermore, unlike the Golomb & Cornelius method which incorporated the child's manipulation of the materials and thus maximized his attention, in the present study only the examiner performed the transformations. Thus active participation on the part of the child may be central to the success of this method. An additional factor to be considered is the social background of our children. The participants in the Golomb & Cornelius study were the offspring of college professors and graduate students, and displayed great verbal fluency as well as an interest in the dialogue with the experimenter. The children in the present study came from a more broadly representative middle-class background including office workers, nurses, school teachers, businessmen as well as professionals. Whether this difference in SES is a potent factor will be the subject of further studies.

Although the effects of the pretense-only condition in the present study are smaller than those reported by Golomb & Cornelius, the superiority and stability of the scores obtained by the combined pretense and conservation group supports the original finding that pretense play facilitates the acquisition of conservation of quantity. This form of training calls upon thought processes already available to the child who in pretense play exercises pretense reversibility and utilizes processes of identity, inversion and compensation, albeit in an intuitive and unreflective manner. In play, children maintain their enduring identity despite the adoption of pretense identities, they maintain complementary relations between their real and their assumed identities, and they cancel the pretense transformations at the end of the game. These processes are quite analogous to the solution required for the conservation task. In order to understand that quantity, despite appearances to the contrary, remains unchanged, the child has to acknowledge the continued identity of the quantity, to realize that changes in one dimension are compensated for by changes in another dimension, and to demonstrate this understanding by canceling the transformation and reestablishing equivalence. While the forms of identity, inversion, and compensation used in pretense play are of a qualitative order, they seem to provide a conceptual link between the preoperational reasoning of the preschool child and the concrete operational reasoning required for the solution of the conservation of quantity task.

The finding that in our design direct conservation training with four year old subjects appears to be less stable and yields more temporary effects, suggests that the mere imposition of rules in an unfamiliar form cannot easily

be assimilated by the child, and thus is less likely to have educational consequences. The results of the combined treatment clearly demonstrated the superiority of this method of training in conservation attainment with four year old preschool children. While our study does not address itself to the educational implications of training preschoolers in conservation or to the desirability of such an intervention, it suggests that the utilization of modes of reasoning familiar to the child and spontaneously employed in a playful context can lead to enduring cognitive gains.

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Footnotes

1. Permission for each child's participation was obtained in writing from each parent.

2. All statistical analyses were based on conserving judgments which were accompanied by adequate explanations. This procedure was adopted by Golomb & Cornelius and by Golomb & Adams, and seemed most appropriate for our experimental design which directly trained the participants, using verbal rules and correcting the child's judgments and explanations. While the present method does not completely rule out spurious modeling effects, judgments which require an adequate explanation may minimize this effect.

Table 1

Mean Chronological Ages, Mental Ages, and IQ of Five Groups of Subjects

Group	N	M	F	Mean Chronological Age	Age Range	Mean Mental Age	Age Range	Mean IQ	IQ Range
Pretense Training	15	6	9	4.6	3.11 - 5.0	6.5	4.11 - 8.3	118	100-136
Conservation Training	15	8	7	4.6	4.0 - 5.0	6.4	4.9 - 8.9	118	104-139
Combined Training	15	8	7	4.6	4.0 - 5.0	6.1	5.1 - 7.3	116	105-123
Exposure Conservation Trials	15	9	6	4.6	3.10 - 4.11	6.3	4.8 - 8.7	118	101-139
Control	15	8	7	4.5	4.0 - 4.11	6.2	4.11 - 7.8	118	106-129

N - number of subjects; M - males; F - females

Table 2

The Effects of Training on Conservation Attainment

Groups	N	Conservers	Judgments & Explanations	Total Score	Mean Score
		Posttest 1			
Pretense Training	15	2	5	10	0.67
Conservation Training	15	6	20	40	2.67
Combined Training	15	9	34	68	4.50
Exposure Conservation	15	0	0	0	0
Control	15	1	2	4	.27
		Posttest 2			
Pretense Training	15	2	8	16	1.07
Conservation Training	15	4	13	26	1.73
Combined Training	15	7	33	66	4.40
Exposure Conservation	14	1	1	2	0.13
Control	14	0	0	0	0
		Combined Posttests			
Pretense Training	15	2	13	26	1.73
Conservation Training	15	6	33	66	4.40
Combined Training	15	10	67	134	8.93
Exposure Conservation	15	1	1	2	0.13
Control	15	1	2	4	0.27

Table 3

Between Group Comparisons on Conservation Posttest Scores

Posttest 1

	Conservation	Pretense	Control
Combined Treatment	$< .025$	$< .025$	$< .01$
Conservation		n.s.	n.s.
Pretense			n.s.

Posttest 2

	Conservation	Pretense	Control
Combined Treatment	n.s.	n.s.	$< .025$
Conservation		n.s.	n.s.
Pretense			n.s.

Table 4

Number of Subjects Who Displayed Different Kinds of Quantity Conservation on Two Posttests

Single Quantities

	Solid		Liquid		Discontinuous	
	PT 1	PT 2	PT 1	PT 2	PT 1	PT 2
Pretense Training	2	2	1	2	0	0
Conservation Training	6	3	3	2	1	2
Combined Training	8	6	7	4	0	2

Two Quantities

Solid & Liquid Quantities

	PT 1	PT 2
Pretense Training	1	2
Conservation Training	3	1
Combined Training	5	4

Solid, Liquid & Discontinuous Quantities

	PT 1	PT 2
Pretense Training	0	0
Conservation Training	1	1
Combined Training	1	3

Note: PT = Posttest